CONTENTS

Title Page i
Dedication iii
Certificate v
Declaration vii
Curriculum Vitae ix
Acknowledgement xi
Contents xiii
Nomenclature xvii
Abstract xix

Chapter 1: Introduction and literature review

1.1 Introduction 1
1.2 Literature review 2
1.2.1 Studies on natural convection from horizontal cylinder with annular fins 2
1.2.2 Studies on horizontal cylinder with eccentric annular fins 4
1.2.3 Studies on natural convection from vertical cylinder with annular fins 4
1.2.3.1 Natural convection from unfinned vertical cylinder 4
1.2.3.2 Natural convection from vertical cylinder with fins 5
1.2.4 Studies on entropy generation due to natural convection 6

1.3 Motivation and objective of the present work 9

Chapter 2: Natural convection heat transfer from a horizontal cylinder with annular fins

2.1 Introduction 11
2.2 Problem description 11
2.3 Mathematical modeling 12
2.4 Numerical procedure 16
2.5 Results and discussion 23
2.5.1 Effect of fin spacing and fin diameter on heat transfer 23

2.5.2 Effect of fin diameter and Rayleigh number on optimum fin spacing for maximum heat transfer 23
2.5.3 Effect of *S/d* and *D/d* on Nu_D and fin efficiency 26
2.5.4 Effect of fin spacing on temperature plume 29
2.5.5 Effect of fin diameter on temperature plume 31
2.5.6 Effect of Rayleigh number on temperature plume 33
2.5.7 Effect of fin spacing on flow field around the fins 33
2.5.8 Effect of fin diameter on flow field around the fins 35
2.5.9 Effect of Rayleigh number on flow field around the fins 37
2.5.10 Temperature Plume and flow field as seen from the side of the tube (on z-y plane) 37
2.6 Some useful correlations 39
2.6.1 Correlation for Nusselt number 39
2.6.2 Correlation for optimum fin spacing 40
2.6.3 Correlation for fin efficiency 42
2.7 Conclusions 43

Chapter 3: Effect of eccentricity on natural convection heat transfer from a horizontal cylinder fitted with annular fins 45
3.1 Introduction 45
3.2 Problem description 45
3.3 Mathematical modeling 46
3.4 Numerical procedure 48
3.5 Results and discussion 49
3.5.1 Effect of eccentricity ratio on heat transfer 49
3.5.2 Effect of eccentricity on temperature plume 51
3.5.2.1 Effect of positive eccentricity ratio on temperature plume at the fin section 51
3.5.2.2 Effect of negative eccentricity ratio on temperature plume at the fin section 52
3.5.2.3 Effect of eccentricity on temperature plume in between the fins in z-y plane 53
3.5.2.4 Effect of eccentricity on temperature plume around the fins x-y plane 54
3.5.3 Effect of eccentricity on flow field around the fins 55
3.5.4 Variation of heat transfer with eccentricity 57
3.6 Correlation for Nusselt number 57

3.7 Conclusions 59

Chapter 4: Natural convection heat transfer from a vertical cylinder with annular fins 61

4.1 Introduction 61

4.2 Problem description 61

4.3 Mathematical modeling 63

4.4 Numerical procedure 67

4.5 Results and discussion 72

4.5.1 Effect of fin spacing and fin diameter on heat transfer 72

4.5.2 Effect of fin diameter and Rayleigh number on optimum fin spacing for maximum heat transfer in turbulent flow 75

4.5.3 Effect of *S/d* and *D/d* on Nusselt number 76

4.5.4 Effect of *S/d* and *D/d* on fin efficiency 78

4.5.5 Effect of fin spacing on temperature plume 82

4.5.6 Effect of fin diameter on temperature plume 83

4.5.7 Effect of Rayleigh number on temperature plume 85

4.5.8 Effect of fin spacing on flow field around the fins 86

4.5.9 Effect of fin diameter on flow field around the fins 89

4.5.10 Effect of Rayleigh number on flow field around the fins 91

4.6 Some useful correlations 93

4.6.1 Correlation for Nusselt number 93

4.6.2 Correlation for optimum fin spacing 95

4.6.3 Correlation for fin efficiency 96

4.7 Conclusions 98

Chapter 5: Entropy generation due to natural convection heat transfer from horizontal cylinder with annular fins 99

5.1 Introduction 99

5.2 Mathematical modeling 99

5.3 Results and discussion 100

5.3.1 Effect of fin spacing and fin diameter on the ratio $(I/Q)_{finned}/(I/Q)_{unfinned}$ 100

5.3.2 Comparison of heat transfer irreversibility and fluid friction irreversibility 101

5.3.3 Contours of entropy generation rate per unit volume with varying fin spacing 102

5.4 Conclusion 104

Chapter 6: Entropy generation due to natural convection heat transfer from vertical cylinder with annular fins 105

6.1 Introduction 105

6.2 Mathematical modeling 105

6.3 Results and discussion 106

6.3.1 Comparison of heat transfer irreversibility and fluid friction irreversibility 107

6.3.2 Effect of fin spacing and fin diameter on the ratio $(I/Q)_{finned}/(I/Q)_{unfinned}$ 109

6.3.3 Effect of fin spacing and fin diameter on Bejan number 111

6.3.4 Contours of entropy generation rate per unit volume with varying fin spacing 113

6.4 Conclusions 115

References 117